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(54) Resilient mounting of vehicle suspension struts

(57) A MacPherson strut type of suspension system, utilising a telescopic shock absorber 32 and a surrounding coil spring 40 utilises a strut upper mounting comprising a single elastomeric ring 58 preloaded between upper and lower retainer members 74 and 76 that are secured to each other and around an opening 38 in a body portion 12 of a vehicle. Bearing means 66, 70, 72, are mounted between a bottom portion of the elastomeric ring and a spring retainer flange 44 for the upper end of the coil spring 40. The piston rod 36 of the shock absorber is secured within a central portion 60 of the elastomeric ring. With this arrangement the preloaded outer portion of the elastomeric ring is subjected to compression forces during jounce and rebound conditions, whereas the preloaded central portion of the ring is subjected to shear forces during such jounce and rebound conditions, thereby providing predetermined different stiffness characteristics for the shock absorber and the coil spring.

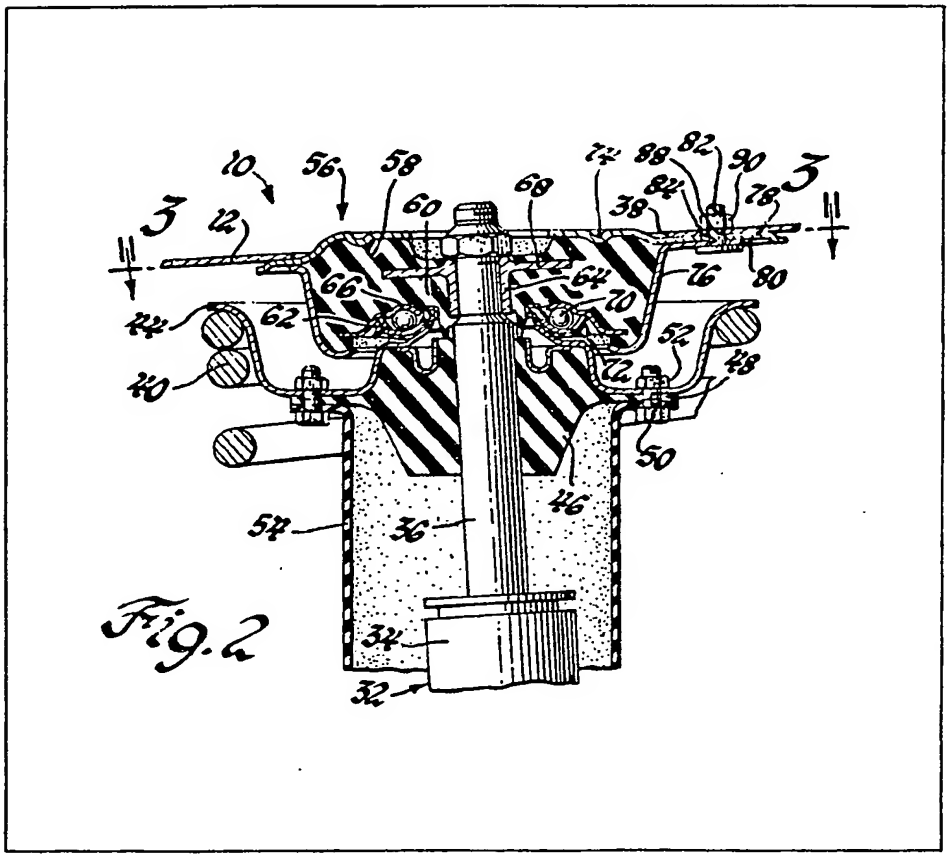

Fig.2

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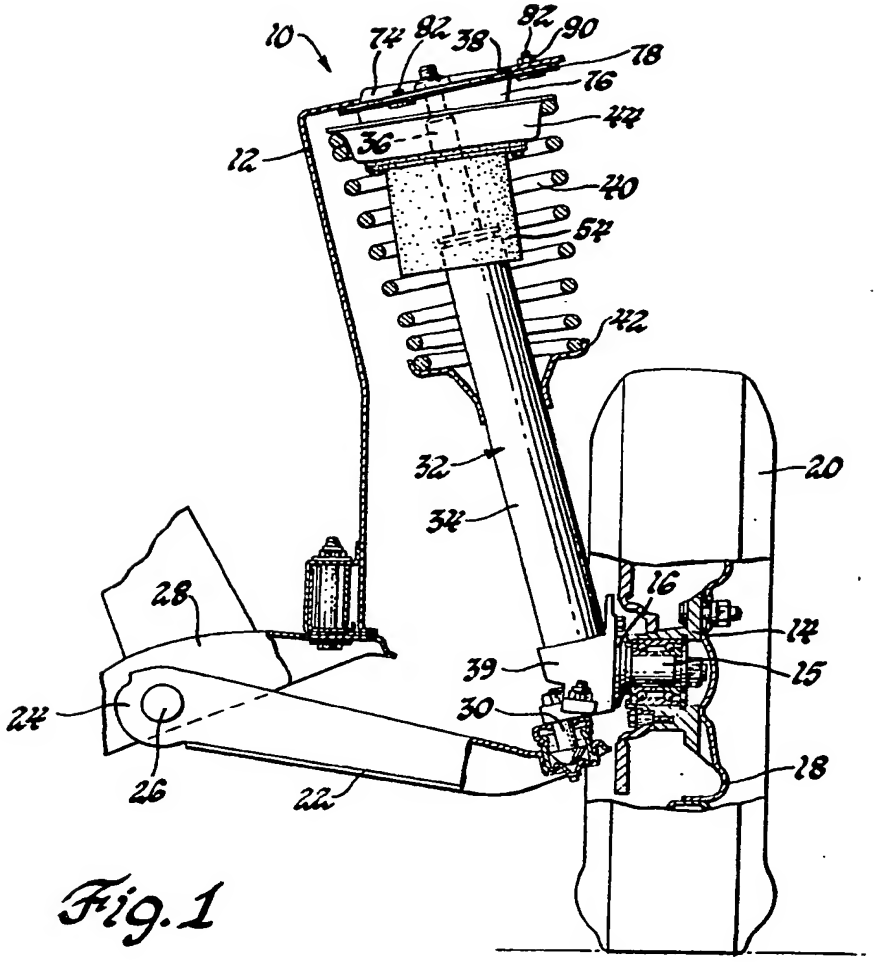

Fig.1

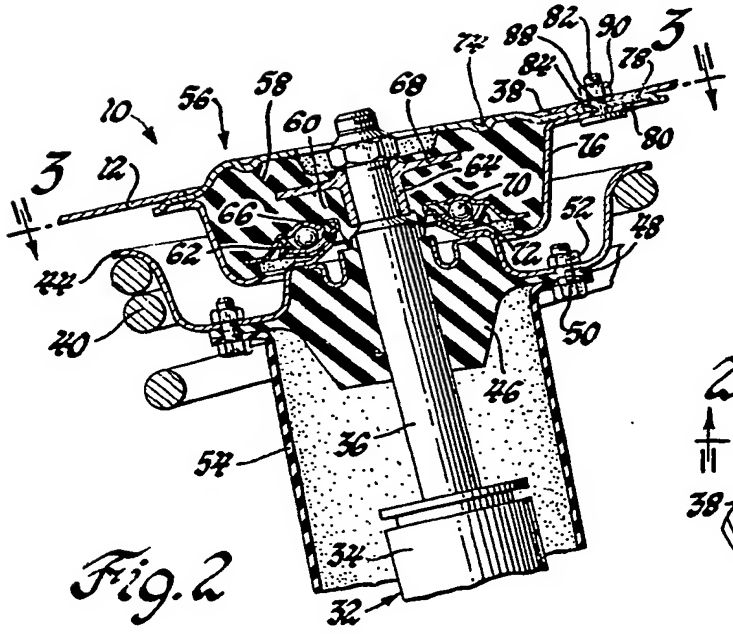

Fig.2

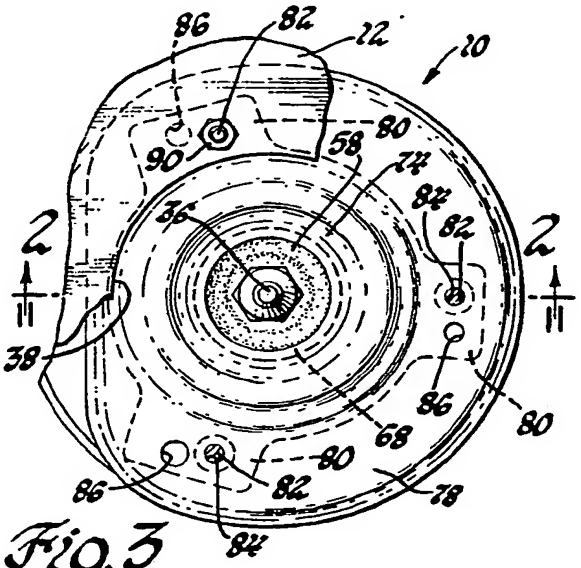

Fig.3

SPECIFICATION

Vehicle suspension systems

This invention relates to vehicle suspension systems.

More particularly, the invention is concerned with improved mounting means at the upper end portion of a MacPherson strut type of suspension.

Heretofore, mounting arrangements for the upper end portions of MacPherson strut suspension systems, wherein a coil spring is mounted around a telescopic shock absorber, have generally included a spring mounting bracket or plate with is mounted on the piston rod adjacent an annular resilient bushing, as shown in United States Patent No. 3,490,785 (Moss), or have embodied concentric dual rubber bushings or sleeves with an intermediate annular metal member, wherein the spring mounting plate is mounted on the metal member, as disclosed in United States Patent No. 3,584,856 (Desbois), and in both types of arrangement the piston rod is secured through the innermost surface of the resilient bushing.

By the present invention there is provided a vehicle suspension system comprising a telescopic shock absorber having an outer casing operatively connected at a lower end thereof to an unsprung mass of the vehicle, and a piston rod extending exteriorly of an upper end of the outer casing to a piston adjacent an opening formed in a sprung mass of the vehicle, a coil spring mounted around the shock absorber and operatively connected at a lower end thereof to a retainer flange mounted on the outer casing, a dual-rate elastomeric mounting comprising a single elastomeric ring preloaded between mounting means that are secured to the sprung mass of the vehicle adjacent to and concentric with the opening in the sprung mass, means connecting the piston rod to a central portion of the elastomeric ring, bearing means operatively connected to a bottom portion of the elastomeric ring, and a spring retainer flange mounted between the bearing means and an upper end of the coil spring, such that, in operation, during jounce and rebound conditions the outer portion of the elastomeric ring is subjected by the spring retainer flange to compression forces, whereas the central portion of the elastomeric ring is subjected by the piston rod to shear forces, thereby providing predetermined different stiffness characteristics for the shock absorber and the coil spring.

Thereby it is possible to achieve an improved, simplified upper mounting means for a MacPherson strut, with a single elastomeric bushing adapted to provide dual stiffness characteristics to the shock absorber and the coil spring, and preloaded to enhance efficiency and durability.

In a preferred arrangement of a vehicle suspension system in accordance with the present invention, a MacPherson strut upper mounting means includes a single elastomeric ring, a bushing bonded to the inner surface of the elastomeric ring and adapted to have the piston rod extension secured therein, and a bearing support ring adjacent a portion of the bottom surface of the elastomeric ring concentric with the centre of the elastomeric ring and adapted to have bearing means abutted thereagainst for supporting an upper spring retainer flange. The elastomeric ring is preloaded by virtue of its outer cylindrical and exposed bottom surfaces being compressed between interconnected upper and lower contoured retainer members. The resulting preloaded outer portion of the elastomeric ring is thus subjected to compression forces during jounce and rebound conditions of the coil spring, and the preloaded centre portion of the elastomeric ring is subjected to shear forces during such jounce and rebound conditions of the piston rod, thereby providing predetermined different stiffness characteristics for the shock absorber and the coil spring.

In the accompanying drawing:—

Figure 1 is a front view, partially in section, of one embodiment of a vehicular front suspension system in accordance with the present invention;

Figure 2 is an enlarged sectional view of an upper portion of the Figure 1 structure, along the plane of the line 2—2 of Figure 3, in the direction of the arrows; and

Figure 3 is a fragmentary plan view along the plane of the line 3—3 of Figure 2, in the direction of the arrows.

In the drawing, Figure 1 illustrates a front suspension system 10 mounted between a tower portion forming part of an upper wheel well of a vehicular body 12, and a wheel hub 14, the latter being rotatably mounted on a wheel spindle 15 formed on a steering knuckle 16. A conventional wheel 18 with tyre 20 is mounted on the hub 14.

The suspension system 10 includes a conventional control arm 22, which in this embodiment is of the wishbone type, having its inner ends 24 pivotally mounted in a bracket 26 in a frame (undercarriage) 28 of the body 12 and its outer end connected by a ball joint 30 to the steering knuckle 16.

A telescopic shock absorber 32 includes an outer casing 34 encompassing a piston (not shown) carried by a piston rod 36 which extends exteriorly of the upper end of the casing and is flexibly connected to the sprung mass constituted by the body 12 adjacent an opening 38 formed in the body. The lower end of the shock absorber casing 34 is mounted in a mounting boss-like bracket 39, formed on or alternatively secured to the steering knuckle 16. A coil spring 40 surrounds adjacent parts of the casing 34 and the piston rod 36, and is mounted at its lower end on a first, lower retainer flange 42 secured to the outer casing 34 and at its upper end against a second, upper retainer flange 44 which is flexibly connected to the sprung mass in a manner to be described. The lower retainer flange 42 may be either concentric or non-concentric with respect to the shock absorber casing 34, depending upon the

particular model of vehicle involved.

A resilient bushing 46 (Figure 2) is shaped to match the inner portion of the underside of the upper spring retainer flange 44, and includes external flange-like tabs 48 secured to the retainer flange 44 by fastener means constituted by bolts 50 and nuts 52. The bushing 46 is mounted freely around the piston rod 36 to serve as a stop member for the cylinder 34. A cylindrical dust shield 54 surrounds the extended portion of the piston rod 36 and is also secured to the upper spring retainer flange 44 by the fastener means 50 and 52.

A dual-rate elastomeric mounting arrangement 56 includes a single elastomeric ring member 58 having an integral hub-like central portion 60 of reduced thickness and a bottom surface 62 formed in a stepped configuration. A metal bushing 64 is bonded to the inner surface of the central portion 60, and a contoured bearing support race (ring plate) 66 is abutted against the bottom surface 62. The metal bushing 64, which is bonded to the inner surface of the central portion 60, includes a radial flange 68 confined within the body of the elastomeric ring, and the radially outer edge portion of the bearing support race 66 is also confined within the body of the ring member 58. A bearing 70 and race member 72 are mounted between the bearing support race 66 and the upper spring retainer flange 44.

The single elastomeric ring member 58 is preloaded to a predetermined extent at its upper, lower and outer surfaces between upper and lower contoured retainer members 74 and 76, respectively, and around the inner metal bushing 64. The retainer members 74 and 76 include, respectively, a flange 78 and a plurality of mounting tabs 80, and the flange and tabs are secured together by fastener means each comprising a bolt 82 which is mounted upwardly through aligned openings 84 formed in the retainer member portions 78 and 80, and staked securely in the upper opening 84. Formed adjacent the openings 84 there are additional aligned openings 86 (Figure 3) merely to facilitate alignment and sub-assemblying of the ring and retainer members. At final assembly on the vehicle, as may be noted in Figure 2, the bolts 82 are mounted through openings 88 formed in the tower portion 12, and are secured by nuts 90.

The steering axis for the wheel 18 passes through the centre of the elastomeric ring 58 and the centre of the ball joint 30 which projects downwardly from the steering knuckle 16. The mounting bracket 39 may be located above or in front of or to the rear of the axis of the wheel 14 to accommodate the drive axle of a front wheel drive vehicle.

The particular mounting arrangements described above relative to the respective upper ends of the coil spring 40 and the piston rod 36 allow the preloaded outer portion of the single elastomeric ring 58 to be subjected to compression forces during jounce and rebound conditions, and the preloaded central portion of the elastomeric ring 58 to be subjected to shear forces during such jounce and rebound conditions, thereby providing independent control of the stiffness characteristics for the shock absorber 32 and the coil spring 40. Since tension forces or stretching tend to degrade rubber, inasmuch as the ring 58 is preloaded there is little likelihood of its being subjected to tensile forces during the normal jounce and rebound conditions. In other words, under normal operative conditions the preloaded rubber ring 58, rather than being stretched, would tend to be urged towards its normal free length, thus enhancing its durability.

The present invention thereby provides an improved, simplified and efficient strut mounting means, wherein a single, preloaded elastomeric ring member provides dual stiffness characteristics for the shock absorber and coil spring, as well as independent control of the two stiffnesses, while maintaining very good durability under operative conditions.

CLAIMS

1. A vehicle suspension system comprising a telescopic shock absorber having an outer casing operatively connected at a lower end thereof to an unsprung mass of the vehicle, and a piston rod extending exteriorly of an upper end of the outer casing to a position adjacent an opening formed in a sprung mass of the vehicle, a coil spring mounted around the shock absorber and operatively connected at a lower end thereof to a retainer flange mounted on the outer casing, a dual-rate elastomeric mounting comprising a single elastomeric ring preloaded between mounting means that are secured to the sprung mass of the vehicle adjacent to and concentric with the opening in the sprung mass, means connecting the piston rod to a central portion of the elastomeric ring, bearing means operatively connected to a bottom portion of the elastomeric ring, and a spring retainer flange mounted between the bearing means and an upper end of the coil spring, such that, in operation, during jounce and rebound conditions the outer portion of the elastomeric ring is subjected by the spring retainer flange to compression forces, whereas the central portion of the elastomeric ring is subjected by the piston rod to shear forces, thereby providing predetermined different stiffness characteristics for the shock absorber and the coil spring.

2. A vehicle suspension system according to claim 1, in which the elastomeric ring is preloaded by virtue of an outer cylindrical and top and bottom surfaces thereof being compressed between contoured upper and lower plate members that are secured to each other and to the sprung mass of the vehicle concentrically with the opening formed therein and constitute the aforesaid mounting means.

3. A vehicle suspension system according to claim 1 or 2, in which the means connecting the piston rod to the central portion of the elastomeric ring comprises a bushing that is secured to the

piston rod and includes a flange portion and is bonded to an inner surface portion of the elastomeric ring.

4. A vehicle suspension system according to claim 2 or 3, in which the spring retainer flange is concentric with the contoured plate members, the bearing means is mounted around the piston rod adjacent the spring retainer flange, and the bearing means abuts against a bearing support ring that is bonded to a portion of a bottom surface of the elastomeric ring and is concentric with the elastomeric ring.

5. A vehicle suspension system substantially as hereinbefore particularly described and as shown in the accompanying drawing.

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